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Toroidal Alfvén eigenmodes excited by energetic electrons in EAST low-density plasmas

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Operation in the quiescent regime with a large number of energetic particles (EEs) in specific energy range (˜ 150–250 keV) have been achieved during the flattop of EAST low-density Ohmic discharges. Toroidal Alfvén eigenmodes (TAEs) excited by EEs are well demonstrated both in the deuterium plasmas and the helium plasmas. The resonance condition for EEs to drive TAEs is discussed and well satisfied for these experimental conditions. The frequencies of these TAEs are in good agreement with ideal MHD theory, after correcting the mass of ion according to the ratio of deuterium to helium for helium plasmas. The energy threshold for EEs to drive TAEs and the plasma operation regime are obtained on the EAST tokamak by statistical results of a series of experiments. Two different slope trends have been observed between the mode frequencies and the Alfvén frequency, analysis show that it is caused by their different radial positions, measured data from reflectometry system and simulated calculations by GTAW code further confirm this results. Moreover, experimental results show that the radial positions that TAEs located are mainly determined by the distribution and evolution of EEs, and threshold for exciting the TAEs is strongly related to populations of EEs. In addition, the damping rates of the TAEs are found to be very sensitive to the energy distribution due to the change of electron density, experiments with different density decay rates are carried out, which verified this results.

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